From Takutai Kāpiti Decision-Making Framework: Phase 2, Task 3: Excluding from long list of actions

The Takutai Kāpiti Decision-making Framework outlines the following tasks for this part of the decision-making process.

Using the long list of options confirmed by the CAP (Coastal Advisory Panel) in Phase 1, the CAP will be tasked with excluding any adaptation options and actions that would not be suitable for the Adaptation Area under consideration. This will be done in a workshop environment where the CAP, along with technical advice from the TAG (Technical Advisory Group), will determine whether an action is not practical for the Adaptation Area, and therefore should be discarded. Reasons for excluding the action from the long list will be recorded in this table.

For simplicity of record against the long list, the following reasons for excluding (A-F) should be considered and recorded where appropriate for excluding. If there are reasons other than these, then they should also be recorded as G - Other:

A. Will not provide for the objectives defined by the CAP

B. Does not have a good track record of being successful in this environment

C. Insufficient or limited space to implement the action

D. Not suitable for the environment is it being applied to

E. It is not a practical solution

F. Limited benefits

G. Other

The remaining actions deemed relevant for application within the Adaption Area by the CAP will form the 'short list' of actions, which can then be used to form adaptation pathways.

This Document: Excluding of long-list options for the Paekākāriki Adaptation Area

This document provides a record of the reasons for excluding long-list areas for the Paekākāriki Adaptation Area (PAA) from both the TAG advice and the CAP's discussion in the workshop.

The first eight columns of the following Table are from the original Long List Adaptation Actions presented to the CAP at their July 2022 CAP workshop, with some amendments based on conversations with the CAP on options for the NAA, CAA, and RAA. In the following Table there are an additional two columns added to the right-hand side of the long list Table. The second to right column contains pre-workshop commentary by the TAG for actions which in their opinion should be considered to be removed from the list for the technically feasibility reasons given above (Reasons B to E) and other (Reason G). Since the Coastal Adaptation Objectives for the Paekākāriki Adaptation Area have not been confirmed yet, the above excluding reason A - not provide for the objectives of the Paekākāriki Adaptation Area, has not been part of the TAG consideration.

Commentary and decisions from the upcoming CAP workshop will be recorded in the right-hand column during the workshop. It is recognized that additional adaptation actions may be excluded from the long-list at the workshop as a result of the discussions and confirmation of the adaptation objectives for the Paekākāriki Adaptation Area.

It is also recognised that the actions remaining on the list may be used at a range of timeframes over the 100 years of the assessment, with some being better implemented in the short term and others in the longer-term as indicated in Column 5 of the Table.

It is further recognised that not all of the remaining actions may be used in a short-listed adaptation pathway which the CAP will be undertaking in Task 4: Develop Pathways (February 2024 CAP Workshop).

Enhance: We maintain and improve what we are already doing

Enhancement actions utilise existing infrastructure, assets, knowledge and information to build on and improve. These actions involve physical works, such as strengthen existing protection structures or dune planting and reshaping; district wide initiatives to increase community awareness around hazards; improvements to environmental monitoring; and improvements to emergency management in large events. These actions build on systems, information, and assets that we already have.

Option	Action	Hazard	Description	Approximate timeframe it could be used for (Short term/ Medium term/ long term)	Optimal environment/setting to be applied	Advantages/Positive	Disadvantages/Limitations	TAG commentary for excluding	CAP commentary
Enhance	Enhance and strengthen existing structures	Erosion	Adding material to existing structures to increase the level of protection (from both overtopping inundation and erosion).	Short term. Could be a medium-long term option following the construction of a new protection structure in an earlier epoch.	Existing structures that are adaptable and can still be utilized, where there is space for increased structure footprint.	▪ Can be low cost ▪ Can be easier to consent than replacement/new protection.	▪ May not have certainty in the asset's performance ▪ Difficult to meet design requirements of material size and shape to provide necessary level of protection. ▪ Long term durability of existing structures not addressed. ▪ May not address other issues (e.g. access, aesthetics). ▪ Limited ability to be adapted in the future to provide for sea level rise.	▪	▪
	Enhance existing inundation protection	Inundation	Increase existing stop banks to provide greater protection from storm surge inundation. Incorporate SLR and higher intensity events into the design of stormwater management when it is being upgraded.	Short to medium term.	Coastal/fluvial environments.	▪ Can be designed or adapted for longer term protection with future sea level rise ▪ Stopbanks/bunds can be grassed over and planted to look more natural along the banks edge. ▪ Utilises existing structures so could be lower cost relative to building new stopbanks.	▪ Depending on how extensive stopbank network is, it could be an expensive exercise due to the length required. ▪ May cause some backing up of the river/lagoon water levels, which may divert the flooding further upstream. ▪ If stopbanks are overtopped water can be trapped with no pathway back to the sea/river.	▪	▪
	Access steps and ramps	Erosion/ Inundation	Structures that provide pedestrian and/or small boat access to the coast.	Short to medium term	Anywhere where access is required to the coast	▪ Allowing for access to the coast (NZCPS alignment) ▪ Way to encourage pedestrians to use access, rather than to walk across dunes and ruin vegetation. ▪ Providing safe access to ensure pedestrians do not need to climb down or over hard structures.		▪	
	Dune and wetland enhancement/resilience	Erosion/ Inundation	Dune enhancement by building wind trap fences on the seaward side of an existing dune to trap sand and promote dune growth, vegetation planting to stabilise dunes, and/or making artificial dunes. Wetland enhancement by managing coastal wetlands and riparian planting. Pest control, weed control and continued maintenance of plantings.	Short to medium term, depending on the level of hazard.	Dune and wetland environments with good sediment supply, with land area behind the beach suitable for planting and enhancement.	▪ Promotes vegetation planting to stabilise the dunes/wetland and dune/wetland growth. ▪ Enhances the dune/wetland ecosystem ▪ Natural beach is a good aesthetic outcome. ▪ Low-cost option ▪ Will increase longevity of the dune/wetland. ▪ Limited consenting required.	▪ Depending on local conditions, it may not be an effective long-term (100 year) solution against sea level rise, particularly on narrow beaches with limited capacity for retreat behind the dune.	▪ The shoreline in PAA is predominantly structured, and therefore no real opportunity for enhancement of dunes or wetlands, except at the Ames Street Reserve, where there is approximately 300m of unprotected shoreline and a small existing patch of existing duneland. The only infrastructure directly landward of the reserve is SH59 which is setback 100m from the coast. ▪ This option would not be a fundamental way to protect the properties and infrastructure within the wider PAA, however would be applicable to	▪

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								this small stretch of shoreline.	
	Continue emergency management	Erosion/ Inundation	Emergency management, including the creation of hazard maps, evacuation plans, civil defence emergency management, and temporary accommodation and protection measures continues.	Short to long term	District wide.	▪ Increased preparation and knowledge behind hazards. ▪ Already have systems in place to further develop and enhance. ▪ Increasing community awareness and knowledge will help them become more aware and accountable for risks. ▪ Being prepared will increase the safety of people during large events (e.g. being able to evacuate).	▪ Does not address the risks to assets and infrastructure.	▪	▪
	Continue environmental monitoring	Erosion/Inundation	Environmental monitoring may include topographic and bathymetric surveys, shoreline mapping, storm events, ecological surveys, structural assessments, and morphological change assessments	Short to long term	District wide in the coastal environment	▪ Allowing monitoring of triggers for understanding of hazards. ▪ Increase understanding of the risks as new information develops ▪ Can be citizen Science based to give community involvement in environmental monitoring	▪ Can be resource intensive over a long timeframe. Requires commitment to establish useful long-term datasets. ▪ Does not directly address the risks to assets and infrastructure.	▪	▪
	Continue to increase community education and risk awareness	Erosion/Inundation	As people build an understanding of the impacts of climate change it is seen to encourage changes in their attitude and behavior, and helps them adapt to climate change. Education and awareness also allows people to make informed decisions and play a role in both climate change mitigation and adaptation. This can be done through organized events, engagement with schools, updating and sharing online resources.	Short to long term	District wide	▪ Increasing awareness ▪ Allowing people to take ownership of their risks as their understanding of the hazards increases.	▪ Can be resource intensive.	▪	▪
	Private owner's responsibility	Erosion/ Inundation	Through planning tools (district and regional), Council allows for owners of private structures to own and maintain their own structures.	Short to long term depending on provisions.	Where there are good condition structures and consistency in materials and level of protection over several property lengths, and there is commitment from land owners to provide and maintain protection.	▪ No cost to council or rate payer ▪ Private owners can manage their own risks	▪ Costs might be too high for private property owners. ▪ Having ad hoc structures could lead to weak spots which could lead to damage of individual properties.	▪	▪

Accommodate: We live with the hazard

Accommodation is about adapting our buildings and infrastructure to be able to withstand the consequences of the hazards. These actions are generally involve works done to individual properties (i.e. flood proofing, raising floor levels), making buildings adaptable and relocatable so they can be removed either temporarily in an event or permanently during retreat a low cost; or increasing the resilience of existing infrastructure where it already exists.

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Accommodate	Relocatable buildings	Erosion/ Inundation	Buildings can be relocatable to move away from the hazard, which can lower the cost of retreating in the longer term.	Short to long term solution, depending on the level of hazard.	Individual property basis, new builds.	▪ Can be applied to individual properties, so can be considered a suitable option where only a few properties/assets are likely to be affected. ▪ Lowers the cost of retreat in the future if buildings are relocatable.	▪ Likely to only be applicable to new builds so does not address risk to existing buildings.	▪	
	Building Design – Raising minimum floor levels of existing buildings	Inundation	Raising the floor levels of existing properties which are at risk from inundation.	Short to long term solution, depending on the level of hazard and how much the floor has been raised.	Buildings that are at high risk of frequent flooding.	▪ Can be a low-cost option if only a few buildings are likely to be affected in an isolated area. ▪ Can directly change the flood risk of an individual property.	▪ Can be an expensive option if lots of buildings require raising floor levels. ▪ May not be possible/practical for some buildings. ▪ Can divert the flood risk to neighboring properties. ▪ Increasing floor levels increases the height of the building which can become aesthetically unpleasing for neighboring properties.	▪	
	Flood proofing buildings	Inundation	Flood proofing measures are best applicable to coastal areas with a small inter-tidal range and where flood depths are low. This involves wet-proofing or dry proofing a building: **Wet proofing** – allowing water to enter the structure but minimizing the structural damage through using flood resistant materials or elevating structures. **Dry proofing** – making buildings water-tight so that water cannot enter.	Short to medium term solution	Buildings that are at high risk of frequent flooding.	▪ Wet proofing can be a low-cost option for areas where the flood depths and risks are low. ▪ Will ensure that a new/ existing building will be protected from small flood events.	▪ Only addresses the risk at an individual property basis. ▪ May not be possible/practical for some buildings.	▪	
	Flood proofing infrastructure	Inundation	Flood proofing infrastructure such as wastewater, stormwater and drinking water infrastructure, telecommunication infrastructure, and roads. This may involve modifying existing infrastructure or designing new or replacement infrastructure to withstand coastal hazards.	Medium-long term solution.	Existing or new infrastructure that is at high risk of frequent flooding, or consequences of being flooded are unacceptable.	▪ Flood proofing existing infrastructure will be a lower cost than replacement as it utilises existing material. ▪ By flood proofing the infrastructure it could reduce the need for maintenance over the lifetime of the asset.	▪ Designing new or replacement infrastructure will be expensive	▪	

Protect: We keep the hazard away

Protection of our people, values, assets and infrastructure from the hazards generally is in the form of soft or hard engineering actions. Soft engineering actions generally involve utilizing natural resources to reshape beaches, add material to systems, or enhance the environment to build resilience. Hard engineering actions are generally in the form of designed protection structures which can be placed along a shoreline.

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Protect	Beach drainage	Erosion	Beach drainage (also referred to as coastal drainage or beach dewatering) involves the placement of drains parallel to the shoreline, under the exposed beach face, which are connected to a well so that water which enters the system can be pumped out. Beach drainage lowers the water table and therefore increases the depth of the unsaturated zone under the ground. This lowering of the ground water table also encourages sediments to be deposited on the beach and reduces the sea-ward transport of sediment and therefore accretes sediment at the shore	Medium to long term, depending on the intensity of the erosion hazard.	Sand beaches where there is mild upper beach and dune erosion.	▪ Encourages sediments to be deposited on the beach and reduces the sea-ward transport of sediment. Can promote accretion on the beach. ▪ Can provide a natural looking aesthetic outcome.	▪ Not as well known and tested of a technique, certainty in success is unknown. ▪ Drain may be exposed during storms.	▪ (B) Does not have a proven track record of being successfully implemented. ▪ (C) Limited space/environmental conditions to implement the option successfully.	▪
	Beach scraping	Erosion/ Inundation	Redistribution of sediment across a beach profile to increase the dune/crest elevation on the beach from taking material from the lower beach and moving it to the upper beach profile.	Short to medium term	Sand or gravel beaches with lowered crests.	▪ Natural beach is a good aesthetic outcome. ▪ Provides good access to the beach. ▪ No adverse effects on coastal processes. ▪ Doesn't cut off any future adaptation pathways that could involve putting in more permanent (soft/hard) engineered structures.	▪ High energy environment will likely move the sediment away from the shoreline fairly quickly, and therefore unlikely to be a long-term solution unless end containments barriers (e.g. small artificial headlands) are included along with regular maintenance top ups and replacements. ▪ There would be on-going whole of life costs involved in continuously providing increasing maintenance requirements. ▪ Disturbance of dune/crest ridge vegetation and ecology. ▪ Ecological impacts of beach scraping in tidal zone on shellfish populations.	▪ (D) Not suitable for the environment it is being applied to – would require the beach to have some surplus material which required redistributing to provide better protection – this is not the case where there are sea walls present. ▪ (E) This is not a practical solution. ▪ (G) This option was removed from consideration by the CAP in NAA, CAA & RAA due to the potential impact on shellfish on the foreshore.	▪
	Dune Reconstruction	Erosion/Inundation	Redistribution of sediment across a beach profile to increase the dune/crest elevation on the beach. This can sometimes require additional sand it be brought into the system to help build up volume if there is not enough sand locally available. The new dune can be replanted to help build resilience and encourage further growth of the dune.	Short to medium term	Sand beaches with lowered crests	▪ Natural beach is a good aesthetic outcome. ▪ Provides controlled access to the beach. ▪ No adverse effects on coastal processes. ▪ Doesn't cut off any future adaptation pathways that could involve putting in more permanent (soft/hard) engineered structures.	▪ High energy environment will likely move the sediment away from the shoreline fairly quickly, and therefore unlikely to be a long-term solution unless end containments barriers (e.g. small artificial headlands) are included along with regular maintenance top ups and replacements. ▪ There would be on-going whole of life costs involved in continuously providing increasing maintenance requirements. ▪ Disturbance of dune/crest ridge vegetation and ecology	▪ If undertaken by itself it would not be appropriate because - (D) it is not suitable for the environment it is being applied to, as there is not space or existing dune environment to undertake reconstruction; and ▪ (C) Insufficient or limited space to implement the action. ▪ **However, there is potential for this option**	▪

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									to be paired with setback/retreat, where a dune could be constructed in the increased coastal margin area.	
	Renourishment (sand, gravel, cobbles)		Erosion	Adding sediment to the beach system, either onshore or in the nearshore.	Short to medium term	Lower energy coastal environment which can retain sediment in the system (e.g. won't be immediately shifted away).	▪ Natural beach is a good aesthetic outcome. ▪ Provides good access to the beach ▪ No adverse effects on coastal processes ▪ Doesn't cut off any future adaptation pathways that could involve putting in more permanent engineered structures.	▪ High energy environment will likely move the sediment away from the shoreline fairly quickly, and therefore unlikely to be a long-term solution unless end containments barriers (e.g. small artificial headlands) are included along with regular maintenance top ups and replacements. ▪ There would be high on-going whole of life costs involved in continuously providing increasing maintenance requirements. ▪ Need readily available source of renourishment material near to the site.	▪ (B) Does not have a good track record of being successful in this environment – Was historically trialed further north in Raumati at Marine Parade and was unsuccessful due to natural sediment deficit. ▪ (D) Not suitable for the environment it is being applied to – current shoreline is structured and has erosion projected in the future. ▪ (F) There would be limited benefits based on what we know about natural processes occurring in the PAA. ▪ **Could be paired with groynes** (artificial headland) **to reduce losses of sediment; and also post dune reconstruction to increase resilience of the dune.**	▪
	Vertical Sea wall	Buried Terminal wall	Erosion	A buried wall (concrete, rock, gabion baskets, timber) at the landward limit of where it is acceptable for the beach to retreat to at some time in the future. Normal beach processes would continue in the intervening years, with the wall slowly becoming exposed until it was acting as a fully functional protection structure holding the shoreline in place.	Medium to long term	Beaches which do not have an immediate erosion hazard, but assets landward of the beach need to be protected in the longer term.	▪ Provides certainty in future proofing erosion, particularly where dynamic short-term shoreline movements are a major issue. ▪ Could be designed to be adapted into a bigger structure once exposed. ▪ Can act as a trigger to show when erosion is becoming a significant issue requiring other planning actions (e.g. managed retreat) ▪ Beach could erode up the structure then reform in the front again as it recovers. ▪ Provides a final line of defense for erosion, generally to protect assets which are located at the back of the beach.	▪ Structure is generally small in size so that it can be buried, once exposed may require raising. ▪ Significant land disturbance required in burying the wall, which may disturb existing infrastructure (roads, pipework etc). ▪ Requires good tie in at the ends of structure to reduce future end effects erosion. ▪ Still likely to suffer beach losses from in front of the seawall once it was exposed.		▪

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							▪ Would allow for access to the beach whilst it is still buried.			
		Vertical Gabion wall	Erosion	Porous structure (wire basket filled with cobble sized boulders), which allows water to pass into and potentially through the structure with sediment movement being restricted by the use of geotextile fabric behind the gabion basket.	Short to Medium term	Low energy coastal environment (e.g. river mouth/lagoon environment).	▪ Porous nature allows absorption of some wave energy from vertical face resulting in less wave reflection and run-up than other vertical wall types, hence less lowering of beach and/or nearshore bed and less wall height required. ▪ Occupies a relatively small footprint. ▪ Very easily adapted for longer-term protection with future sea level rise by adding additional gabion units. ▪ Less expensive than sheet pile or concrete vertical sea wall options.	▪ Site works and ground disturbance for construction required. ▪ Some beach and/or nearshore bed lowering likely to occur. ▪ Less durable than other vertical wall types with performance relying on the integrity of the wire mesh reliance, therefore whole-of-life costs may be higher.	▪ (D) Not as suitable for the open coast environment as the other proposed materials and would lack resilience in high energy environments. Wires and cobbles can breakdown in coastal environments and require ongoing maintenance and replacement.	▪
		Vertical sea walls (concrete, timber, sheet piles)	Erosion/ Inundation	Solid vertical barrier along shoreline which prevents the passing of water and sediment between the hinterland and the sea.	Medium to long term	Higher energy coastal environments (e.g. exposed open coast).	▪ If the wall is of sufficient height, it is very effective at preventing erosion (and inundation) of the hinterland. ▪ Occupies a relatively small footprint. ▪ Has good durability, particularly sheet piles and concrete.	▪ Poor wave energy absorption from vertical face results in: 1) Reflection of energy resulting in lowering of the beach and/or nearshore estuary bed which over time results in reduction of intertidal vegetation habitat and potentially erosion and instability of the toe of the wall. 2) Higher wave run-up, resulting in need for increased structure height to prevent overtopping and back-scour compared to other engineering options. ▪ Need for relatively large-scale site works and ground disturbance for construction (compared to other engineering options). ▪ Difficult transition from vertical walls to other protection options. ▪ Relatively expensive compared to other engineering options, particularly for sheet piles and concrete. ▪ Does not look natural in a coastal environment.		▪
	Stepped sea wall	Stepped concrete block wall	Erosion	Stepped concrete blocks placed along the shoreline to provide required crest height to prevent overtopping and prevent erosion.	Medium to long term	Low energy coastal environment (e.g. river mouth/lagoon environment).	▪ Provide a designed level of protection. ▪ Will provide good protection against scour along a shoreline.	▪ Not suitable in high energy environments as blocks are not interlocked, so could be displaced easily.		▪

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		Geotextile Sand Containers	Erosion	Stepped solid barrier made of geotextiles along shoreline which prevents overtopping and scour.	Medium to long term	Low energy coastal environment (e.g. river mouth/lagoon environment).	▪ Can be placed over existing raised banks, scarps and bunds to enhance protection. ▪ Longshore flexibility to fit to shoreline shape. ▪ Can be designed or adapted for longer-term protection with future sea level rise. ▪ Damage/failure releases sand back onto beach	▪ Larger footprint than vertical seawalls. ▪ Would require a local sand supply to fill the containers. ▪ Does not look natural in the coastal environment and can deteriorate over time. ▪ More easily damaged than hard units and can be vandalized		▪
		Interlocking pre-caste concrete block seawall	Erosion/ Inundation	Hard protection structure. Solid, stepped or vertical barrier constructed by interlocking concrete shapes normally constructed within the beach footprint to 'hold' the shoreline in a fixed location and prevent further shoreline retreat for a considerable timeframe depending on design and cross shore location. Depending on height, it could also reduce/eliminate wave overtopping in storm events, hence also provide protection from coastal inundation.	Medium to long term	Higher energy coastal environments (e.g. exposed open coast).	▪ Occupies a relatively small footprint. ▪ Has good durability. ▪ Can be easily designed or adapted for longer-term protection with future sea level rise. ▪ Irregular shape variations in the front face breaks up wave run-up onto structure reducing overtopping potential and reflection of energy back onto the foreshore, therefore reducing beach losses in front of the wall. ▪ Can be tiered to reduce wave impacts, and can be placed over existing raised banks, scarps and bunds to enhance protection. ▪ Flat top and width of the interlocking wall allow for pedestrian provide access along the structure. ▪ Can provide opportunities for flora development in the steps	▪ Need for relatively large-scale site works and disturbance of the beach to ensure the structure is well founded against toe scour. ▪ Requires good tie in at the ends of structure to reduce end effects erosion, which is common issue with seawalls on open coasts. ▪ Still likely to suffer beach losses from in front of the seawall, potentially reducing beach recreational value (e.g. ability to walk along beach at all tides), but this will be at slower rates than for vertical seawalls. ▪ Difficult transition from this type of structure other protection options in the future. ▪ Initial construction costs likely to be relatively expensive compared to soft engineering options. ▪ Difficulty in providing access over seawalls - limited to fixed locations of steps. ▪ Does not look natural in the coastal environment.		▪ CAP is interesting in innovative stepped and interlocking protective structure in addition to traditional seawalls.
		Reno Mattress	Erosion	Sloping wire basket filled with cobble sized boulders. Placed at steeper slopes to protect the edge and at lower slopes below the edge to prevent lowering of the beach/upper intertidal nearshore.	Short to medium term	Low energy coastal environment (e.g. river mouth/lagoon environment).	▪ Porous nature allows absorption of some wave energy resulting in less wave reflection and run-up than other vertical wall types. ▪ If overtopped, water can flow back through the structure to the sea. ▪ Could be adapted for longer-term protection with future sea level rise by adding additional mattresses or gabions. ▪ Likely to be less expensive than other sea wall options. ▪ Flat top and width of the reno mattress allow for pedestrian access along the structure.	▪ Does not look natural in the coastal environment. ▪ Less resilient than other vertical wall types with performance relying on the integrity of the wire mesh baskets in an abrasive saltwater environment, with structural failure position with the failure of one gabion basket. Therefore, lifetime of the structure likely to be less, and whole-of-life costs may be higher. ▪ The use of the top of the structure for pedestrian access is likely to increase the wear on the wire baskets, reducing lifetimes and increasing maintenance costs.	▪ (D) Not suitable for the environment being applied to – Reno Mattresses are generally effective in lower lying, low energy environments. Unlikely to have a long life span on the open, high energy coast. ▪ **May be suitable in combination with sea walls as toe scour protection but wouldn't consider them suitable on their own.**	▪

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								▪ Need for relatively large-scale site works and disturbance of the beach/coastal environment to ensure the structure is well founded against toe scour. ▪ Requires good tie in at the ends of structure to reduce end effects erosion, which is common issue with seawalls on open coasts. ▪ Likely to be some localised scour around the base of the structure.		
		Rock Revetment	Erosion	Large sized rock placed on design slope on a shoreline to provide required crest height and mass to prevent overtopping or movement of individual rock units that would expose edge to erosion.	Medium-long term	Higher energy coastal environments (e.g. exposed open coast).	▪ Can be placed over existing raised banks, scarps and bunds to enhance protection. ▪ Good durability, particularly if using high density rock types (e.g. basalt). ▪ Easy maintenance in adding additional rocks as required. ▪ Can be designed or adapted for longer-term protection with future sea level rise.	▪ Needs suitable rock availability and need to sort rock to design size/grade. ▪ Larger footprint than vertical seawalls, greater potential impact on foreshore habitats. ▪ Cost depends on rock availably and distance to source. ▪ Need for site works and disturbance of the beach to ensure the structure is well founded against toe scour. ▪ Requires good tie in at the ends of structure to reduce end effects erosion, which is common issue with seawalls/revetments on open coasts. ▪ Still likely to suffer beach losses from in front of the seawall, potentially reducing beach recreational value (e.g. ability to walk along beach at all tides), but this will be at slower rates than for vertical seawall options. ▪ Difficulty in providing access over revetment. ▪ Does not look natural in the coastal environment.		▪
	Groynes		Erosion	A groyne (or artificial headland) is a structure built perpendicular to the shoreline out into the sea to intersect sediments that are transported along the coast by longshore drift. Can be built out of rock, timber, concrete materials.	Short to long term	Lower energy coastal environment with known longshore sediment transport mechanisms and good sediment supply.	▪ Can be durable depending on the material used (e.g. rock). ▪ Can promote accretion and buildup of sediment, but only in a localised area.	▪ For maximum efficiency and length of coast protected, needs to be of sufficient length to cross the surf zone to avoid sediment leakage around the structure(s). ▪ To protect sufficient length of coast at each settlement would require a multiple groyne field ▪ Does not look natural in a coastal environment. ▪ Can have downstream effects by stopping sediment supply reaching the downdrift of the groynes.	▪ (E) Not a practical solution as it moves any coastal erosion issues along the coast due to trapping of longshore sediment ▪ (D) There is not a strong sediment supply to this area of the coastline, and therefore would require pairing with renourishment to effectively trap sediment.	▪

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								▪ Unlikely to be effective in a high energy coastal environment.		
	Vertical permeable sill		Erosion	A structure within the gravel beach that dissipates wave energy, reducing erosion losses through backwash and longshore drift and promotes the retention of gravel behind the structure.	Short to medium term	Gravel beach environment	▪ Promotes the retention of gravel behind the structure. ▪ Reduces erosion losses through backwash and longshore drift	▪ Uncertainty around how successful it may be. ▪ Will not look natural in a coastal environment.	▪ (B) Uncertainty on success as no track record. ▪ (D) Not suitable for the sand beach environment	▪
	Detached breakwaters and artificial reefs		Erosion	Offshore structure placed in the nearshore close to the shore to reduce the wave energy that is reaching the shore through dissipation, reflection and diffraction of oncoming waves. This creates a low-energy environment in the lee of the structure that encourages the deposition of sediment and the localised build-up of a wider beach.	Medium to long term	Lower energy coastal environment (e.g. low energy wave climate or sheltered environment)	▪ Reduces the wave energy that is reaching the shore through the dissipation, reflection and diffraction of oncoming waves. ▪ Creates a low-energy environment in the lee of the structure that encourages the deposition of sediment and therefore the localised build-up of a wider beach. ▪ Utilising good design material, there can be opportunities for habitat creation and enhancement (e.g. oyster reefs).	▪ Unlikely to be effective in a higher energy environment as structure could be easily displaced or damaged. ▪ High cost. ▪ Likely down drift effects from disruption of sediment supply past the breakwater structure.	▪ (D) It is not suitable for the environment it is being applied to along a structured coastline. ▪ (F) Limited benefits – the lack of sediment supply to this section of coast means that there would most likely be little to no formation of salient beaches, and therefore reduces benefits of these structures.	▪
	Flood controls	Controlled/ planned mouth openings of lagoons and rivers	Inundation	Controlled openings of lagoons and stream mouths which naturally close with beach sediment building up across the mouth. Planned opening of the mouths will allow water to flow out to the sea/ lagoon in large fluvial events and reduce water backing up in tributaries further upstream.	Short to medium term.	River mouth environments.	▪ Can be done on an 'as required' basis before forecasting large rainfall events to increase the efficiency of the discharge in the event. ▪ Low cost. ▪ No aesthetic effects from structures.	▪ Potential to allow sea water into the lagoons/river mouth during large coastal storms, which could result in sea water inundation. ▪ Requires reliable information around storm intensity, duration and timing as well as predicted coastal conditions to allow informed decision prior on opening prior to the event. ▪ Potential Health and Safety issues if attempting to open once storm has arrived.	▪ (D) Not suitable in the environment it is being applied to, typically helps fluvial/pluvial flooding, and could let storm surge into the estuary and exacerbate the hazard. ▪ (F) Limited benefits for coastal flooding.	▪
		Flapped culvert outfalls at smaller inlets	Inundation	Construction of culvert outfalls with flap gate valve at the entrance of a small inlet which would allow water to flow out of the inlet, but not in from the sea.	Short to medium term	Existing culverts or stormwater infrastructure.	▪ Can be effective at restricting sea water coming into a lagoon or wetland environment.	▪ Only cost effective to undertake the works on smaller inlets. ▪ Requires some elevation difference between the lagoon/wetland and sea to get water to flow through the flap valve. ▪ Sediment transport across and along the shore could block the flap valve for culverts on the beach. ▪ Requires frequent maintenance to ensure pipe does not get blocked with debris ▪ For raised pipe culverts need to accommodate for beach erosion at seaward end of the structure.		▪

Protect: We keep the hazard away

Protection of our people, values, assets and infrastructure from the hazards generally is in the form of soft or hard engineering actions. Soft engineering actions generally involve utilizing natural resources to reshape beaches, add material to systems, or enhance the environment to build resilience. Hard engineering actions are generally in the form of designed protection structures which can be placed along a shoreline.

Option	Action	Hazard	Description	Approximate timeframe it could be used for (Short term/ Medium term/ long term)	Optimal environment/setting to be applied	Advantages/Positive	Disadvantages/Limitations	TAG commentary for excluding	CAP commentary
							▪ Would become less effective as sea level rises.		
	Flood gates	Inundation	Adjustable gates used to prevent storm surges from entering existing waterways, in turn preventing up-stream overtopping and flooding.	Medium to long term	River mouth environments	▪ Effective way to reduce effects of storm surges travelling up waterways.	▪ Can be high cost. ▪ Does not look natural in a river mouth environment.	▪ (D) Not suitable in the environment it is being applied to, likely disproportionate to the scale of coastal flooding. ▪ (F) Limited benefits for coastal flooding. There is only one small inlet in the PAA.	▪
	Storm surge barriers	Inundation	Storm surge barriers are hard engineered structures that are primarily designed to prevent inundation due to storm surges in tidal inlets, rivers and estuaries, while also decreasing reliance on other flood defenses inland of the barrier	Long term	River mouth environment	▪ Prevents inundation due to storm surges in tidal inlets, rivers and estuaries. ▪ Decreases reliance on other flood defenses inland of the barrier.	▪ Very high cost due to high requirements of construction work.	▪ (E) It is not a practical solution. ▪ (F) Limited benefits in relation to the scale of works. There is only one small inlet in the PAA.	▪
	Pump stations	Inundation	A pump station is a storage and collection chamber that lifts and distributes stormwater when it cannot naturally be carried by gravity. This helps discharge excess stormwater in large events.	Medium to long term	Low lying settlements which are flooded in large events	▪ Effective way to help manage the discharge of water in a large event. ▪ Can exclude tidal inflow to stormwater systems.	▪ Is not a preventative option which stops the area being flooded in the first place. ▪ Have a carbon cost associated with use and maintenance. ▪ Can have negative environmental effects.		▪
	Stopbanks	Inundation	Engineered stopbanks (most likely earth bunds), along the settlement boundaries to allow surface flooding to occur on the low-lying land around the settlement, but not allowing it to enter into the settlement. Crest height of the stopbanks would be informed through a design level for a specified flood frequency from both coastal and fluvial sources.	Medium-long term	Isolated communities/ settlements with land area around it which would be acceptable to allow to flood.	▪ Effective way of controlling water flow in an extreme event. ▪ Can be designed or adapted for longer term protection with future sea level rise. ▪ Can be grassed over and planted to look more natural along the banks edge.	▪ Depending on how extensive stopbanks were could be an expensive exercise due to length required. ▪ Would still result in some overland flooding to occur up to the settlement boundary, which could have an effect on landuse (e.g. saltwater effects on crop land). ▪ If stopbanks are overtopped water can be trapped with no pathway back to the sea/river. ▪ Difficult to consent.		▪
	Earth Bunds	Inundation	Continuous elongated structure designed to protect low-lying areas from inundation. Bunds are similar physical structures when compared to stopbanks and serve a similar purpose to reduce flood risk, they can be quickly built and generally use local materials, and only involve minor foundation preparations.	Short term	Low energy environment (e.g. ponding water, not high energy flows) which is trying to keep water out.	▪ Lower cost ▪ Quick to construct as require only minor foundation preparations.	▪ Shouldn't be placed in a high energy environment. ▪ Generally, a temporary measure.		▪

Retreat: We move away from the hazard

Retreat is generally a form of land acquisition by one party in a hazardous area in order to move people away from the hazard permanently. There are several mechanisms which can be used to do this which can allow for different levels of compensation (e.g. cost or land), as well as different timeframes for the land to be utilised for before retreat is required.

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Retreat	Buyouts/Land Acquisition	Erosion/ Inundation	Land buyout programs involve the local/national government acquiring land in at-risk areas by agreement, to reduce vulnerability to hazards. Buyouts involve the transfer of title to land and are typically only used in very high risk areas due to the cost associated with them.	Long term	Areas where the risk to hazards is intolerable (both flood and erosion)	▪ Removes the hazard risk by relocating people away from the hazard. ▪ Landowners receive a payment/compensation for their property.	▪ Potential to be a costly exercise for council/government. ▪ Generally, a last resort option for communities. ▪ Both the affected community and wider community perception of this option is generally negative as they are worried about the cost via rates/taxes. ▪ Results in dispersal of community to other areas of the country/district – Councils will need to have factored this into strategies.	▪ It is recommended that retreat is considered as a broad option by the CAP, and the details of the actions to implement the retreat are considered further after the Takutai Kāpiti process is completed.	▪
	Future Interests	Erosion/ Inundation	The acquisition of a future interest involves the purchase of a right to acquire land in specified circumstances in return for an agreed upfront fee. For example, it may be agreed upon that once a certain height of sea level rise has been reached, the holder of the future interest (usually a government agency or council) has the right to acquire the land.	Long term	Areas where the risk to hazards is intolerable (both flood and erosion)	▪ Removes the hazard risk by relocating people away from the hazard. ▪ Allows land to be utilised until the risk becomes intolerable. ▪ Landowners receive a payment/compensation for their property.	▪ Potential for it to be a costly exercise. ▪ Generally, a last resort option for communities. ▪ Community perception of this option is generally negative.		▪
	Land Swaps	Erosion/ Inundation	During a land swap, landowners in a hazard zone are given the opportunity to swap their title to land for a comparable sized parcel in a lower risk area. The land that has been swapped then acts as a buffer against coastal hazards	Long term	Areas where the risk to hazards is intolerable (both flood and erosion)	▪ Removes the hazard risk by relocating people away from the hazard. ▪ Landowners are compensated. ▪ Opportunity for community to stay together.	▪ Potential for it to be a costly exercise to local/national government.		▪
	Leasebacks	Erosion/ Inundation	Leasebacks involve the acquisition of at-risk land by local council/ national government with provision for it to be leased back to the former owner or a third party with terms and conditions that facilitate the management of hazards. The former owners or third party, now the lessee, pays rent and uses the land in accordance with the terms of the lease, but no longer owns the land	Long term	Areas where the risk to hazards is intolerable (both flood and erosion)	▪ Removes the hazard risk by relocating people away from the hazard. ▪ Allows land to be utilised until the risk becomes intolerable.	▪ Could be uncertainty around when people will need to relocate.		▪
	Re-establish the line with a setback seawall **(NEW from RAA)**	Erosion	Retreating the minimum number of properties possible and re-establishing the shoreline landward of the existing shoreline with a constructed sea wall. This is a hybrid approach of retreat and hard engineering.	Medium to long term	Areas where the risk to erosion hazards is intolerable	▪ Removes the hazard risk by relocating people away from the hazard. ▪ Allows land to be utilised until the risk becomes intolerable. ▪ Potential to creates space on the beach for re-establishment or natural defences.	▪ Could be uncertainty around when people will need to relocate. ▪ Costs associated with re-establishing the line (e.g. cost of retreat + hard engineering).	▪	▪

Avoid: We don't move into the way of the hazard in the first place

Actions which are considered to 'avoid' the hazard are generally planning tools which will help future-proof the district. These planning tools are generally low cost to implement and will help prevent putting assets and infrastructure in places which could be susceptible to hazards in the future, however they generally do not address the risk to existing infrastructure and assets.

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Avoid	Building design – Raising minimum floor levels of new builds	Inundation	Planning provisions in place for potentially susceptible areas to ensure floor levels are above design flood levels for new builds.	Medium-long term solution.	New builds in areas that are susceptible to flooding.	▪ Increase the life and reduce the need for regular maintenance of the asset. ▪ Increase safety for building occupants.	▪ Raising flood levels of new buildings will involve extra engineering and materials for construction resulting in increased costs. ▪ Can divert the flood risk to neighboring properties. ▪ Increasing floor levels increases the height of the building which can become aesthetically unpleasing for neighboring properties. ▪ May not be possible/practical for some buildings. ▪ Does not deal with access issues to property in flood events	▪	▪
	Reducing further intensification or development	Erosion/ Inundation	Planning restrictions to reduce further development or intensification within settlements that are likely to be affected by hazards in the future.	Medium-long term solution	New builds or developments.	▪ Will reduce the number of assets exposed to coastal hazards in the future. ▪ Low-cost option as is based on planning provisions rather than protection/infrastructure works.	▪ Does not deal with existing assets or properties that are at risk. ▪ Decreased area of land in the district which could be developed.	▪	▪
	Trigger-based or time limited land use consents	Erosion/ Inundation	Trigger based or time limited land use consents include conditions linked to hazards such as sea level rise, flood depths, or erosion rates that create a finite term for a particular land use. The land use consents allow development or redevelopment with the expectation that such uses can only continue until specified trigger points are reached or for a specified time period.	Short to long term	New builds, developments or land uses.	▪ Low-cost option ▪ Protects private property from erosion/inundation damage when the hazard reaches a certain level. ▪ Allows for land to be used whilst the risk is low.	▪ Costs associated to private owners for relocation at the end of consent. ▪ Costs involved for council to have to provide short term services to the property which would eventually need to be removed.	▪	▪
	Zoning and setback controls	Erosion/ Inundation	▪ Identifying and allowing increased development density in lower risk areas, and identifying areas where new development is not permitted. ▪ Changing future land uses in at-risk areas from low resilience to high resilience (e.g. from residential to public space) Using planning policy and rules (Regional and District) to prohibit hard shoreline protection structures and promoting natural shoreline protection measures that support inland ecosystem migration.	Medium to long term	New development in areas which could be susceptible to coastal hazards.	▪ Reduced risks of damage to buildings and infrastructure in the future. ▪ Low-cost option as is based on planning provisions rather than protection/infrastructure works	▪ Decreased area available for development could result in an increase in land costs. ▪ Does not deal with existing assets or properties that are at risk.	▪	▪
	Transferable development rights	Erosion/ Inundation	Transferable development rights (TDR's) are a mechanism that can be used to increase development potential in areas where development is desired, and decrease or eliminate the potential in areas that should be preserved,	Long term	Areas where development is not desired, with rights transferred to an area where development is desired.	▪ Reduces future risk by not allowing development in undesirable locations.	▪ Only effects future development, not existing developments.	▪ (E) Not a practical solution – Unlikely to be implemented in the Kāpiti Coast District.	▪

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Option	**Action**	**Hazard**	**Description**	**Approximate timeframe it could be used for (Short term/ Medium term/ long term)**	**Optimal environment/setting to be applied**	Advantages/Positive	Disadvantages/Limitations	**TAG commentary for excluding**	**CAP commentary**
			without requiring public investment. Development rights are separated from the land and can be transferred from one parcel over to land in an area where development is considered appropriate or is even desired. By purchasing development rights, a developer could increase the density of dwellings in their development; and land where the rights were transferred from would not be able to be developed any further.						